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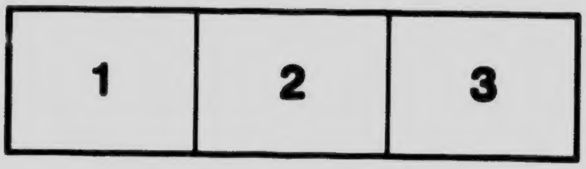

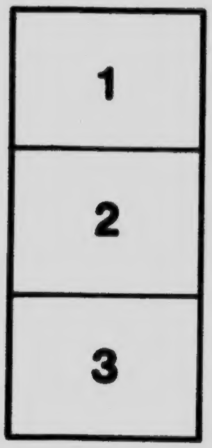

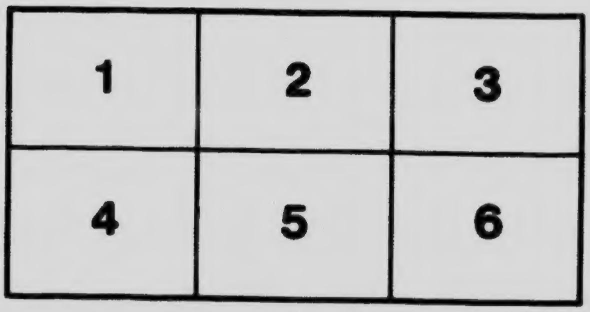

MEMORANDUM

REGARDING

NATIONAL INDUSTRIAL DEVELOPMENT IN CANADA

SUBMITTED TO

THE RIGHT HONOURABLE SIR ROBERT BORDEN, G.C.M.G.,
PRIME MINISTER OF CANADA, MAY, 1916,

BY

CERTAIN MEMBERS OF THE CANADIAN SOCIETY
OF CIVIL ENGINEERS

AND

SIR CHARLES ROSS, BART

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PUBLICATIONS OF THE

CANADIAN SOCIETY OF CIVIL ENGINEERS

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ORDERED TO BE PRINTED AND DISTRIBUTED
TO THE
MEMBERSHIP OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS
BY RESOLUTION OF THE ANNUAL MEETING, 1917.

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TO THE
RIGHT HONOURABLE
SIR ROBERT BORDEN, G.C.M.G.,
PRIME MINISTER
OF CANADA,
OTTAWA.

SIR,

Acting on the suggestions of Sir Charles Ross and subsequent discussions, the undersigned engineers have the honour to transmit for your consideration a memorandum of their views regarding a National Industrial Development Plan for the Dominion. While we appreciate that this highly important matter has, no doubt, already received much careful consideration by the Government, nevertheless we sincerely trust that this memorandum may prove of service to you, and that you may find our suggestions acceptable. We submit them from a sense of patriotic duty and because we believe that Canada may well follow the example of the United States and other countries in calling upon engineers and scientists to render assistance, not only in these critical times, but in those which will succeed the war.

We beg to remain,

Your obedient servants,

C. ROSS,
C. H. McLEOD,
R. A. ROSS,
WALTER J. FRANCIS,
H. R. SAFFORD.

Montreal, May 15, 1916.

MEMORANDUM

REGARDING

NATIONAL INDUSTRIAL DEVELOPMENT IN CANADA

TO

THE RIGHT HONOURABLE SIR ROBERT BORDEN,
G.C.M.G., ETC., ETC.,
PRIME MINISTER OF CANADA.

BY

R. A. ROSS,
C. H. MCLEOD,
WALTER J. FRANCIS,
H. R. SAFFORD,
MEMBERS OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

AND

SIR CHARLES ROSS, BART.,

MEMBER OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

MAY, 1916.

OUTLINE OF MEMORANDUM

I. THE NECESSITY FOR A NATIONAL INDUSTRIAL DEVELOPMENT PLAN.

II. THE RESULTS DESIRED THROUGH A NATIONAL INDUSTRIAL DEVELOPMENT PLAN.

III. A SUGGESTED METHOD OF PROCEDURE TO OBTAIN THE NECESSARY INFORMATION FOR THE ESTABLISHMENT OF A POLICY.

IV. THE FORMATION OF A PERMANENT CONSULTING BOARD.

V. THE FUNCTION OF THE CONSULTING BOARD.

VI. THE CREATION AND MAINTAINANCE OF A DEPARTMENT OF INVESTIGATION, RESEARCH OR REFERENCE.

DIAGRAM SHOWING RELATIVE MEMBERSHIPS IN THE VARIOUS ENGINEERING SOCIETIES IN CANADA.

PREPAREDNESS — CHART OF PROPOSED ORGANIZATION FOR CANADA.

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I.

THE NECESSITY FOR A NATIONAL INDUSTRIAL DEVELOPMENT PLAN.

The history of any community or country is a record of the cycles of dynastic, economic or industrial change, the period of change in each instance being marked by a pause in the established order of progress.

The Dominion of Canada in common with the rest of the civilized world is at this time experiencing an interruption in its course of rapid development. Her position to-day may be likened to that of an industrial enterprise which has been financed and made ready to operate, and which has reached the time when dividends must be earned upon the expended capital before further capital is obtainable for increasing the equipment. In such a case prudent foresight dictates the taking of stock and the organizing of the enterprises along lines which will ensure co-operation among the different departments with a view to the largest possible production.

In this country the Government through its various activities has taken stock to some extent of our land, forest and mineral resources, and has in a degree also interested itself in investigations of the manufacture of certain products such as steel and paper.

The curtailment of imports and the increasing demands resulting from the present war has compelled Canada to depend upon and to develop a number of her own resources. Zinc, for example, heretofore largely produced abroad, is now being smelted in this country, and magnesite, formerly imported, is now being mined, utilized and exported in considerable quantities. Phosphates, recently discovered, may later be added to our productions.

It would therefore appear that if a concerted effort were made to determine our requirements for domestic and foreign trade and to investigate the results from an economic standpoint, the country as a whole and our industrial enterprises individually would be placed in a position to develop and increase their activities along logical lines within the limits of known resources.

A knowledge of the mere existence of raw materials is insufficient. It is essential that their character, best uses and final fabrication into marketable products should be studied. Teamwork by the business interests, led, directed and assisted by the Government, would appear to be the proper method of systematizing all our forces in order that the greatest good to the greatest number may result.

The beginning of a cycle of industrial production has arrived, and if Canada is to increase her industrial weight in the world or even maintain her relative importance and her normal rate of increase, it is imperative that concerted action be taken towards co-ordinating her efforts as other countries are doing.

II.

THE RESULTS DESIRED THROUGH A NATIONAL INDUSTRIAL DEVELOPMENT PLAN.

A community is an economic unit, and the mechanisms of that unit should be so co-ordinated as to produce the largest and most far-reaching results. A primitive community, fed, clothed and housed, having no further necessities is an agricultural state only. Rapid increase of population and urban concentration demand the creation and development of new mechanisms to provide food, clothing and habitations. Industrial enterprises must be created to support the population. Means of communication and transportation must also be established for the handling of either raw or manufactured products among the various groups and between the point of production and the transportation outlets of the country. There will therefore immediately spring up a demand for products other than bare necessities. As everything is derived from the earth two questions arise, the first being whether or not the additional products can be obtained economically from the resources of the country, and the second whether or not these additional products may be economically turned into finished products within the country. The correct answers to these questions demand close study on the part of the most scientifically trained minds.

At the present time the industrial enterprises of the country are working individually, each towards its own end, without being mobilized for efficient production from a national standpoint. It is obvious that systematic co-operation of the various enterprises will result in benefit to the country as a whole.

We are of the opinion that information regarding the resources of the country and the results of the study of the economics of the industrial situation should be made and rendered available to the public. If this were done present undertakings would benefit and many new enterprises would spring up with a reasonable prospect of success. The Government is the only organization which can properly co-ordinate, instruct and give direction to the activities of the country. If furnished with properly ascertained facts and with co-ordinated Government guidance, no industry, whether established or newly formed, can fail to benefit itself and the whole community.

To be more specific we mention a number of points which will doubtless arise for consideration in the working out of a national development plan.

(a) The gathering of statistics of the products of the country as regards both quality and quantity, the conditions of production or growth, the cost of production and the cost of marketing.

(b) An investigation as to the possibility of the economic production of any article of commercial importance not now manufactured, mined or grown in Canada.

(c) The most profitable methods of manufacture or growth of present or future products, and the increase of output. This involves provision for research, trade schools, and the intimate personal training of the farming community by means of model farms and otherwise.

(d) Complete information regarding the most advantageous markets, a point which involves full study of the problems of transportation.

The results which should flow from this work are,—

(1) More complete utilization of the national resources of the country,

(2) The general introduction of more scientific and commercially profitable methods of production,

(3) An increase in production by reason of the improved methods and widened fields of operation,

and (4) A reduction in cost to the consumer through the elimination of unnecessary handling and improvement in transportation.

III.

A SUGGESTED METHOD OF PROCEDURE TO OBTAIN THE NECESSARY INFORMATION FOR THE ESTABLISHMENT OF A POLICY.

It is a well-established fact that the material development of modern civilization is in the hands of the engineer and the chemist.

The necessity for a national industrial development plan and the results desired therefrom have been fully recognized by other nations. It is needless at the present time to refer to the fact that Germany recognized the need very early, and had long since begun to reap the results the German Government desired. The economic and military preparedness of Germany has indicated to the rest of the world not only the advisability but the absolute necessity of scientific handling of the economic resources and forces of the community.

Spurred on by recent events, Great Britain, France and the United States of America have each in its own way seriously taken up the subject,—one of the most important of the present day. The war over, competition will be unprecedented. With Europe impoverished as a result of the struggle her immediate need will be employment for the industrial population, in order not only to prevent starvation in the industrial ranks, but as far as possible to regain the lost wealth and to recover the lost trade.

Although affected favorably rather than otherwise by the present situation, the United States recognizes the above facts and realizes that future competition is something which may only be met by the most thorough preparation. The Americans have therefore taken up the question of national preparedness and have appointed what is known as the Naval Consulting Board consisting of representatives nominated by the great engineering and scientific bodies of the United States, namely,—American Society of Civil Engineers, American Institute of Electrical Engineers, The American Society of Mechanical Engineers, American Institute of Mining Engineers, American Chemical Society, American Electrochemical Society, American Mathematical Society, American Aeronautical Society, The Inventors Guild, The American Society of Automobile Engineers and American Society of Aeronautic Engineers.

Originally the Naval Consulting Board was intended to act in an advisory capacity with regard to naval affairs only, but its activities have since its organization been extended to include the investigation of the industrial resources of the country with a view to advising on a national policy therefor. It is interesting to note that practically the first recommendation made by this body was for the establishing of a national laboratory devoted to the solving of problems in chemistry, metallurgy, aeronautics, electricity and kindred subjects, and the placing of the information so obtained at the disposal of the community.

The recommendation for a national laboratory was made notwithstanding the fact that the Bureau of Standards of the United States, already established about fifteen years and quite broad in its field of action, has been doing excellent work and rendering valuable service to all classes of the community. In making the recommendation the Naval Consulting Board doubtless had in mind the development of equipment especially suited to the requirements of the army and the navy on such a scale as would demonstrate results before attempting commercial manufacture. By this course all new developments in guns, aeroplane engines and the like may be thoroughly tried out before the placing of large contracts by the Government.

The organization of the Naval Consulting Board has placed the scientific and technical talent of the country at the disposal of the United States without cost for professional service.

The French Republic has organized a civilian board similar to the United States Naval Consulting Board and has raised it to the dignity of a ministry (Le Ministère des Inventions). Great Britain has also enlisted the services of a board of civilian scientists and technologists with a view to the utmost development of the nation's industries for the prosecution of the war.

In view of the action of the United States, France and Great Britain, we are not suggesting a new or untried principle. This is further confirmed by the bibliography attached hereto. If engineering may be turned to the advantage of the country, we conceive it to be our duty to respectfully suggest that an invitation to co-operate be extended to the engineering and scientific societies in order that they may be in a position to render an official service to the Dominion.

The Government of the United States in appointing the Naval Consulting Board selected engineers who have wide knowledge of engineering economics, thereby admitting that many of the problems of the industrial community are both scientific and economic in their nature. It was recognized also that the Government of the United States itself could not meet a situation of this kind through its own bureaux since they are lacking in that contact with commercial conditions which is the essence of the case. Further, no mobilization of industrial organizations could be expected from the interested business enterprises acting apart from the Government. In other words, it was recognized that between the Government and industry there was required a body commanding the respect of both and recognized as authoritative by reason not only of its scientific attainments but also by reason of its disinterestedness. Under these conditions the Government of the United States naturally turned to the engineering and scientific societies as being the only group from which could be expected the necessary technical and economic knowledge coupled with freedom from the rivalries of the commercial world.

We are therefore encouraged to express the opinion that the Canadian Government cannot do better than address the engineering and scientific societies of Canada inviting them to appoint from their number representatives whose advice would be at all times available to the Government. We feel sure that the engineers and scientists in Canada have as much public spirit as their professional brethren in the United States, and that a properly authorized consulting board of engineers would draw to itself the best talent in the country, and that without remuneration.

Following this idea we venture to express the view that the necessities of the immediate present at least might be met by selecting representatives of the civil, mechanical, electrical, mining and chemical engineers.

There is in Canada one engineering organization, namely the Canadian Society of Civil Engineers, which embraces all branches of engineering and may be taken to correspond largely to the five great scientific bodies from which the Government of the United States selected the great part of its Naval Consulting Board. There are in addition two other organizations of less magnitude and which include in their membership a number who are also members of the Canadian Society of Civil Engineers. These two are The Canadian Mining Institute and The Society of Chemical Industry. The Royal Society of Canada may also be considered a scientific society, but the great majority of its members are devoted to philosophy and literature. The accompanying chart indicates the number of fully qualified technical men in each of the organizations named.

In order that our view may be either confirmed or modified we beg to suggest that the Government call prominent members of the industrial, engineering and scientific communities into its counsel and question them as to the necessities of the case and the best methods of procedure.

IV.

THE FORMATION OF A PERMANENT CONSULTING BOARD.

Assuming that the results of the investigation made along the suggested lines have been favorably considered by the Government and found acceptable in a broad way to all parties, it becomes pertinent to indicate the possible organization and power of such a body.

The introduction of a consulting board into the mechanism of government should not result in any upsetting or changing of the present Government organizations. On the contrary the Consulting Board should be supplementary to and independent of the executive and be free to act either in the interest of any individual department of the Government or in the interest of the Government as regards its general policy in relation to industrial development.

Possibly the Government may later consider it advisable to establish a "Ministry of Industrial Development" or a "Ministry of Science", but if so this does not in any way effect the principle of the present suggestion. We have attached hereto a diagram indicating our ideas of the function of the Permanent Consulting Board and its relation to the Prime Minister.

We trust we may be pardoned for suggesting that the personnel of the permanent Consulting Board should be free from political, individual or trade bias. The members should be in a position to deal with the technical matters presented to it in the same disinterested spirit as that with which the Bench acts, and in the suggestion referred to above this feature has been carefully kept in mind.

Assuming then the concurrence of the engineering and the scientific bodies above referred to, we would suggest that the Consulting Board be composed of two representatives in civil engineering, two representatives in mechanical and electrical engineering, two representatives in mining and metallurgical engineering, and two representatives in chemical engineering, all nominated by their respective societies to act each during the pleasure of the Government or of the nominating bodies. Further we would suggest that the recall of any member be at the option of either the Government or the Society, replacement, however, to be always at the discretion of the Society.

The official headquarters would presumably be at Ottawa in an office provided by the Government, together with a well paid and highly competent engineering secretary.

The operations of the Board will require a certain amount of detail work usually performed by subordinates. We believe that the Consulting Board should be authorized to appoint the necessary subordinates to carry out details.

If it be found desirable to make a census or investigation of the industries of the country the Board might call upon non-paid technical assistants from the branches of the societies in the different Provinces, following the course pursued by the Naval Consulting Board of the United States in investigating the industrial resources of each State.

V.

FUNCTION OF THE CONSULTING BOARD.

The function of the Consulting Board is outlined in the diagram already referred to. Briefly, it should act as consulting engineers to the Dominion Government represented by the Prime Minister, independent of any department of the Government yet available through the Prime Minister to all, in precisely the same way that the general manager of a large corporation has consulting engineers at his call, not on his staff but available to take up independently of the working organization all such technical or economic problems as he may desire to have solved.

VI.

THE CREATION AND MAINTENANCE OF A DEPARTMENT OF INVESTIGATION, RESEARCH OR REFERENCE.

If the Consulting Board be constituted along the lines we have suggested it will probably recommend that the Government establish a national testing and investigating laboratory for technical tests, investigation, research, reference or experiment. Such a laboratory would do for the Government precisely what any laboratory department does for a large manufacturing company,—namely, investigate the materials supplied, the processes employed in producing finished products and the economics of production as related to technical matters.

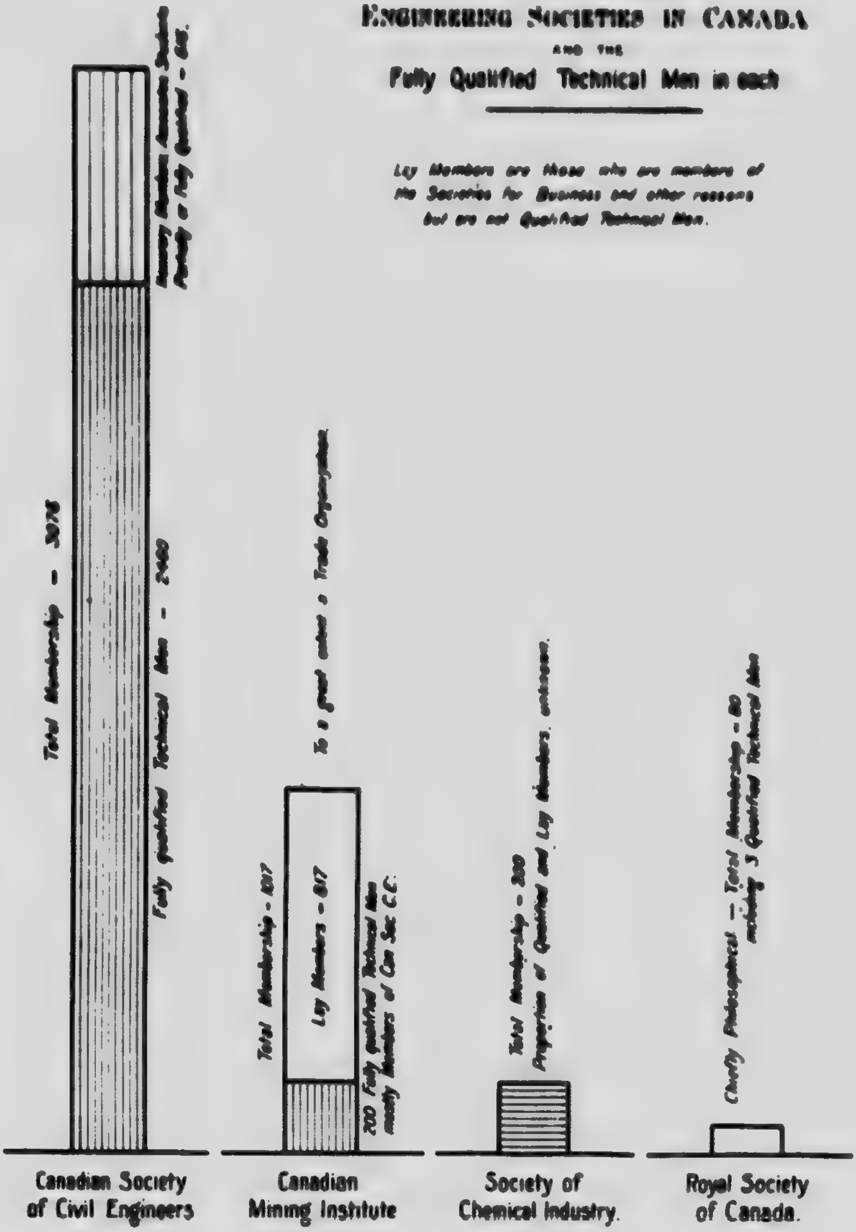
The whole is respectfully submitted in what we believe to be the best interests of Canada.

C. Ross,
C. H. McLeod,
R. A. Ross,
Walter J. Francis,
H. R. Safford.

Montreal, April 20, 1916.

DIAGRAM
SHOWING RELATIVE MEMBERSHIPS
IN THE VARIOUS
ENGINEERING SOCIETIES IN CANADA
AND THE
Fully Qualified Technical Men in each

Lay Members are those who are members of the Societies for Business and other reasons but are not Qualified Technical Men.



· PREPAREDNESS ·

CHART OF PROPOSED ORGANIZATION FOR CANADA

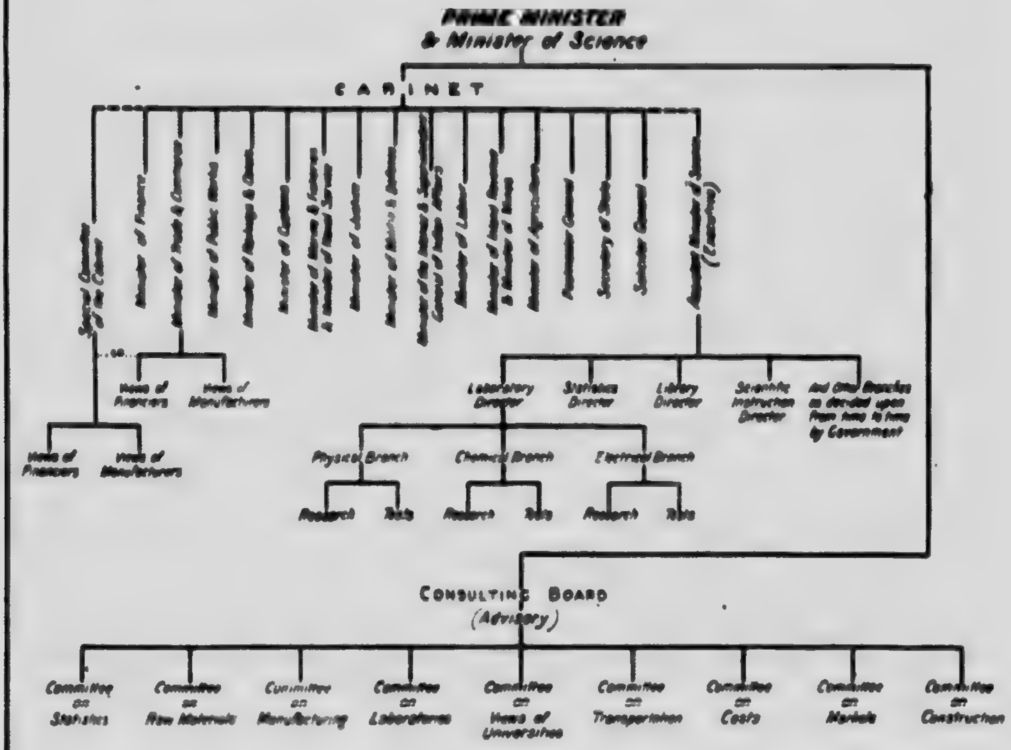
SHOWING

The Relations of the Consulting Board to the Prime Minister
the Cabinet and the Departments of the Government
and
The Methods of obtaining the Essential Facts and the Views of the People
without Duplication of Effort

The Chart assumes that the Government has decided to institute a Department of Science in co-operation with a Consulting Board, and wishes to establish a National Laboratory.
The Consulting Board has then to advise the Government on two points,—

A – The Essential Facts
B – The Methods of Determination of the Essential Facts

The Chart shows how the Consulting Board obtains the Complete Information.
The Chart also assumes that the Government desires the Views of Manufacturers and Financiers, and it therefore indicates the Method whereby this may be accomplished either by the Department of Trade and Commerce or by a Special Committee of the Cabinet.


PRIME MINISTER
& Minister of Science
CABINET
Special Committee of the Cabinet
Minister of Finance
Minister of Trade & Commerce
Minister of Public Works
Minister of Railways & Canals
Minister of Customs
Minister of Marine & Fisheries & Minister of Naval Service
Minister of Justice
Minister of Militia & Defence
Minister of the Interior & Superintendent General of Indian Affairs
Minister of Labour
Minister of Inland Revenue & Minister of Mines
Minister of Agriculture
Postmaster General
Secretary of State
Solicitor General
Assistant Minister of Science (Executive)
Views of Financiers
Views of Manufacturers
Views of Financiers
Views of Manufacturers
Laboratory Director
Statistics Director
Library Director
Scientific Instruction Director
And Other Branches as decided upon from time to time by Government
Physical Branch
Chemical Branch
Electrical Branch
Research
Tests
Research
Tests
Research
Tests
CONSULTING BOARD
(Advisory)
Committee on Statistics
Committee on Raw Materials
Committee on Manufacturing
Committee on Laboratories
Committee on Views of Universities
Committee on Transportation
Committee on Costs
Committee on Markets
Committee on Construction

BIBLIOGRAPHY

◆

American Association for the Advancement of Science.
Science Magazine, N.S., Vol. 39, p. 680, 1914.

◆

Bacon, R. F., Research and Progress in American Manufacturing.
Scientific American Supplement, Vol. 80, p. 334, 1915.

◆

Breslauer Bezirksverein deutscher Ingenieure.
Industrie und Ingenieurwerke in Mittel und Niederschlesien.
Breslau, 1911.

◆

British Diplomatic and Consular Reports, April 1900.
Report of the economic position of the German Empire in 1900. Discusses the development of trade, maritime interests, present commercial policy, finances, expenditure for army and navy, with tables for comparison.

◆

Bulletin Société d'Encouragement pour l'Industrie Nationale, May-June, 1915.
German Economics. Influence of her industry on the war.

◆

Campbell, H. H., Causes of Germany's Industrial Prosperity.
Engineering Magazine, Vol. 48, pp. 801-807, March, 1915.

Cambon, V., Les procédés de l'industrie Allemande.
Mem. Soc. Ing. Civ. de France, pp. 532-572, April 1908.

◆

Carnegie Institution of Washington, Research in China.
Washington, D.C., 1907-1913.

◆

Castle, W. E., Research Establishments and Universities.
Science Magazine, N.S., Vol. 40, p. 447, 1914.

◆

Cattell, James McKeen, Scientific Societies and Associations.
Publishers, J. B. Lyon Co., Albany, 1904.

◆

Dooley, W. H., Engineering Methods in Germany and America.
Cassier's Magazine, Vol. 40, pp. 61-69, May 1911.

◆

Dorsey, Herbert G., Research Work at the National Cash Register Co.
Sibley Journal of Engineering, Vol. 28, p. 115, 1914.
Ithica, N.Y.

◆

Duncan, R. K., Industrial Fellowships of Mellon Institute.
Science Magazine, N.S., Vol. 39, p. 672, 1914.

◆

Engineer, London. German Engineering in 1906.
Vol. 103, p. 277, March 22, 1907.

◆

Engineer, London. German Industrial Competition after the War.
Vol. 119, pp. 245-246, March 12, 1915.

Festgabe der Königlichen technischen Hochschule in München zur Jahrhundertfeier der Annahme der Königswurde durch Kurfürst Maximilian iv., München, 1906.

◆

Fleming, J. E., The Organization of Scientific Research.
Royal Society of Arts Journal, London, Vol. 64, pp. 245-263, 1916.

◆

Hale, G. E., First Half Century of the National Academy of Sciences.
Science Magazine, N.S., Vol. 39, p. 189, 1914.

◆

Hale, G. E., National Academies and the Progress of Research.
Science Magazine, N.S., Vol. 38, pp. 681-698, 1913, and Vol. 39, pp. 189-200, 1914.

◆

Hamer, W. A., The Value of Industrial Research.
Scientific Monthly Lancaster, Pa., Vol. 1, p. 86, 1915.

◆

Hemberstone, T. L., Industrial Scientific Research.
Quarterly Review, New York, pp. 224-520, 1915.

◆

Horner, J., The Industrial Advance of Germany.
Cassier's Magazine, Vol. 25, pp. 515-525, April, 1914.

◆

Institut du Mois Scientifique et Industriel.
Paris, 1910.

John, W., Die ostdeutsche Industrie.
Zeit. d. Ver. Deutscher, Ing., Vol. 34, pp. 1053-1060, June, 25, 1910.

◆

Junge—Hermsdorf, F. E., Germany's Industrial Policy in contrast to American Tendencies.
Engineering Magazine, Vol. 44, pp. 680-689, 842-851, 1913.

◆

Kahn, Julius, Münchens Groszindustrie und Groszhandel.
München, 1891.

◆

Kilian, W., Sur Quelques Mesures "d'après-guerre" dans l'organisation des recherches Scientifiques.
Revue Scientifique, Paris, 1916. An. 54, sem. 1, p. 33-40.

◆

Lanz, Heinrich. Fünfzig Jahre des Wirkens in Landwirtschaft und Industrie, 1859-1909. Berlin 1909.

◆

Little, Arthur D., Industrial Research in America.
Journal of Industrial and Engineering Chemistry, Easton, Pa. Vol. 5, p. 793, 1913.

◆

Matschoss, C., Die Maschinenfabrik H. Wolf, Madgeburg, Buckau, 1862-1912.
Madgeburg, pref. 1912.

◆

Matschoss, C., Geschichte der Firma Gebrüder Sulzer Winterthur und Ludwigschafen a Rh.
Berlin, 1910.

Magee, L. J., The German and American Peril.
Engineering Magazine, Vol. 30, pp. 481, 641-652, 816-822, January, March, 1906.

▼

Meeting of Scientific Societies, 1913.
Science Magazine. N.S., Vol. 38, p. 860, 1913.

▼

Ministère d'Instruction Publique, des Beaux-Arts et des Cultes.
Rapports Scientifiques sur les travaux entrepris en 1914 au moyen de subventions.

France, Caisse des Recherches Scientifiques,
Melun, Imp. Administr. 1905.

▼

Mulhall, M. G., Industrial Advance in Germany.
North American Review, January, 1898.

▼

Research Corporation, Certificate of Incorporation. By-laws. Purposes. New York, 1912.

▼

Research Bureau of Chemists' Club. New York, 1915.

▼

Review of Reviews, Industrial Research and the Mellon Institute.
Review of Reviews, Vol. 52, p. 621, 1915.

▼

Richards, J., Notes on the Industries of the Upper Rhine.
Journal Assoc. of Engineering Societies, Vol. 27, pp. 515-525, July, 1901.

Rud-Sack, 1863-1913. Lebensgeschichte des Begründers. Entwicklung und heutiger Stand des Werkes.
Leipsig, 1913.

◆

Seidel und Naumann Aktiengesellschaft, Fierzig Jahre Fabrikationsgeschichte der Firma, 1868-1908.
Berlin, 1908.

◆

Matschoss, C., Beitrage zur Geschichte der Technik und Industrie.
Berlin. Verlag von J. Springer, 1909-1915. 6 Vols.

◆

Stephens, P. V., Vital Importance of Research Work.
Iron Tradesman, Delton, Ga., 1916.

◆

Thompson, E., The Field of Experimental Research.
Electrical Review, Vol. 55, p. 138 and 152, New York, 1899.

◆

United States Consular Reports. Commerce and Industries of Germany in 1900.
U. S. Consular Reports, No. 1185, Nov. 9, 1901.

◆

Whitney, W. B., Relation of Research to the Progress of Manufacturing Industries.
Annals American Academy of Political Science, Vol. 52, p. 86, 1915.

THE MODERN PRINTING COMPANY,
MONTREAL.